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A ring Ti/dye laser was purchased from Coherent Laser, model 899-21. The laser has been used in experiments involving metastable atom beam cooling. During this work the investigators developed a method of measuring laser line width that can be directly related to the fundamental quantities time and distance. Two spectra taken with the ring laser are included with this report.

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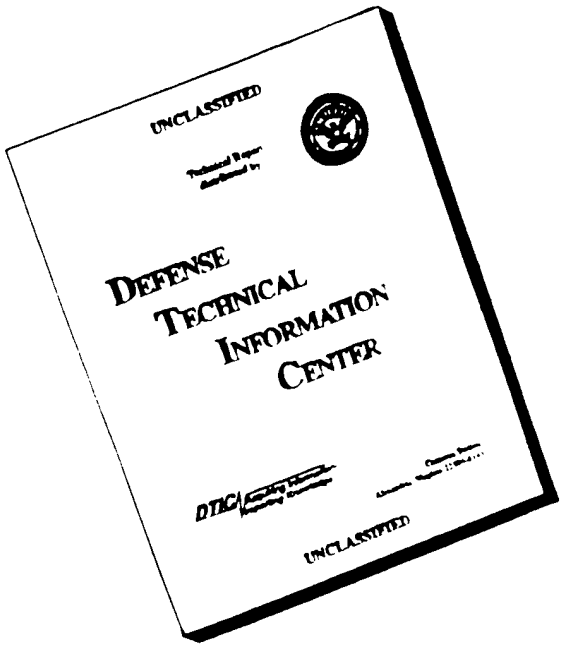

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FINAL TECHNICAL REPORT
RESEARCH INSTRUMENTATION FOR INVESTIGATIONS IN ATOMIC, MOLECULAR AND OPTICAL PHYSICS

95-1-0515

USAFOSR GRANT # F49620-~~95-0515~~

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A ring Ti/dye laser was purchased from Coherent Laser, model 899-21. The laser was delivered approximately February 1, 1996. The laser was not accepted at this time , however, due to difficulties with the specified line width. The investigators worked with the designers of the laser system to resolve the problems and the manufacturer agreed to redesign two circuit boards in the control system. This resulted in the laser system meeting the required specifications. The redesigned boards were delivered in July 1996.

The laser has been used in experiments involving metastable atom beam cooling. During this work the investigators developed a method of measuring laser line width that can be directly related to the fundamental quantities time and distance. We believe this method may have broad future application. The work is in preparation for publication.

Two spectra taken with the ring laser are included with this report. Figure 1 shows the result of laser cooling a beam of metastable argon atoms from a velocity of ≈750 m/sec to a velocity of ≈240 m/sec. The velocity width of the cooled atom beam has been reduced to 6%. Figure 2 shows laser cooling with the laser detunned 200 MHz. This gives a final velocity of 162 m/sec, which is approximately the low velocity limit of our apparatus in its current configuration. Figure two also illustrates the result of the laser cooling as it shows time spectra with the laser on and off. The two spectra shown were taken with a time channel width of 40 μsecs and a path length of 1.8 m. The final velocities are calculated knowing that the atoms travel .31 m with their initial velocity, a constant deceleration for .77 m and a final path length of .73 m, at constant final velocity.

Currently a magnetio-optical trap is being added to the apparatus to confine the cool atoms after which scattering experiments will commence with the goal of measuring the "S" wave scattering length of various metastable atom partners.

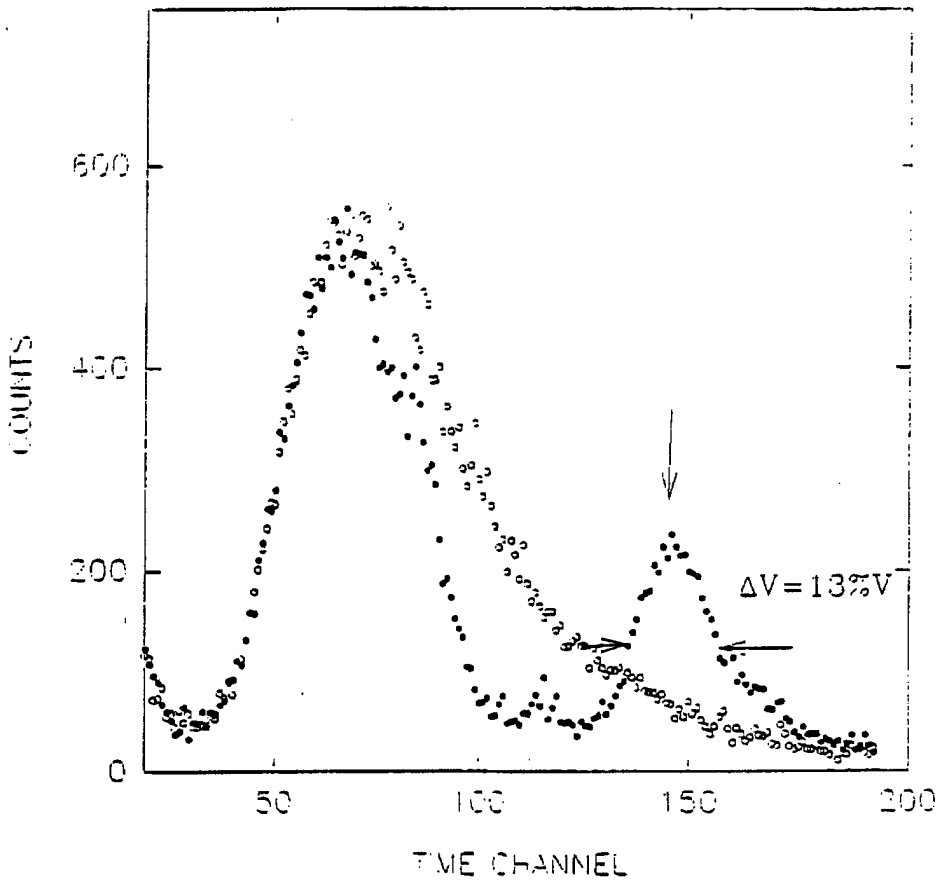

Figure 2 Hollow circles – TOF Distribution of the metastable atoms without the laser.

Filled circles – TOF Distribution when the laser is detuned 200 MHz Red from resonance, and TMF with the currents 1.1, .7, .67, .61, .58, .43, .3 is used. Initial magnetic field 420 Gauss.

Total TOF=3.94ms

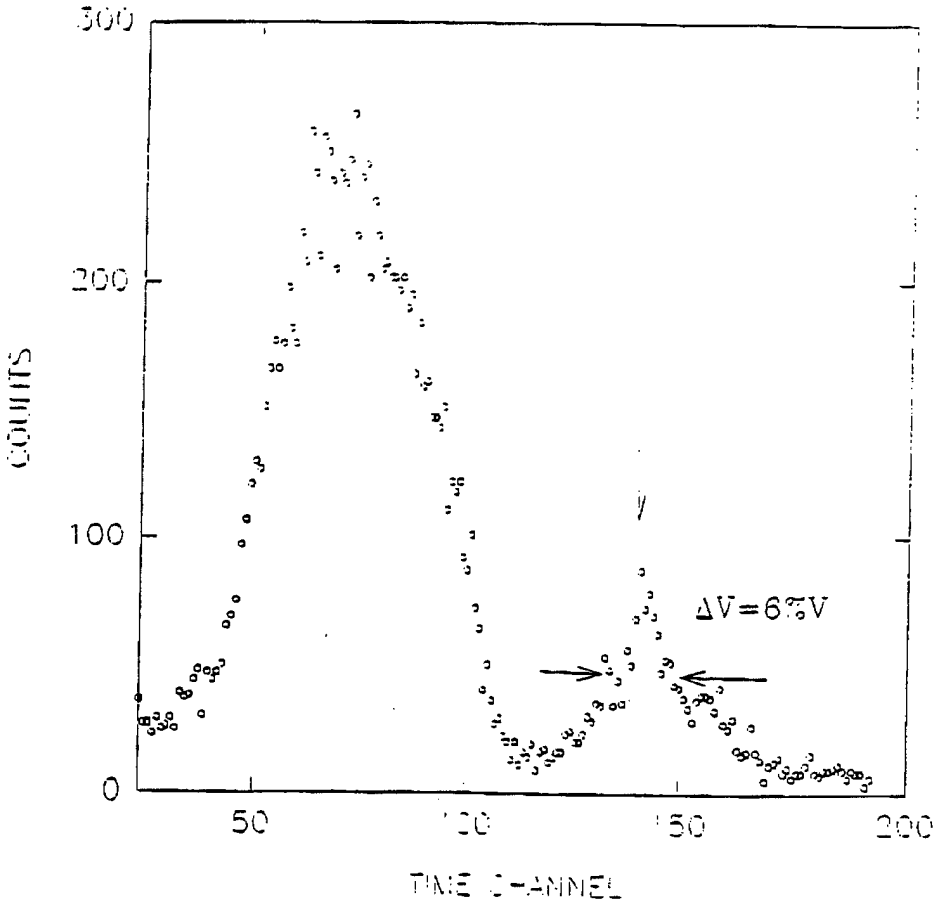

Figure 1 TOF Distribution of metastable atoms when the laser is detuned 300 MHz Red from resonance and a TMF with B_0 = 170 Gauss is used.

TOF=5.64 ms